Enzymatic Synthesis of Artificial Polysaccharides Leads to New Biomaterials

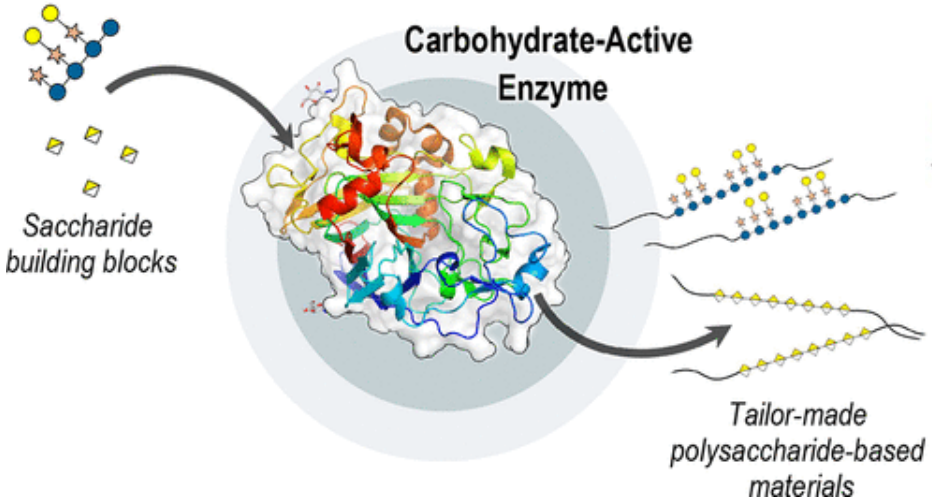
U.S. DEPARTMENT OF ENERGY | Office of Science

Background

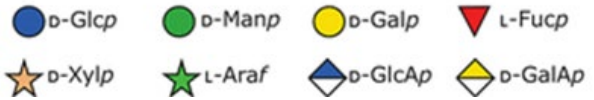
- Polysaccharides are the most important renewable polymers on Earth and hold an enormous potential for the production of ecofriendly functional materials. Derivatization of polysaccharides obtained from plant biomass paves the path forward for the design and manufacturing of advanced materials with specific properties adapted to meet definitive needs.

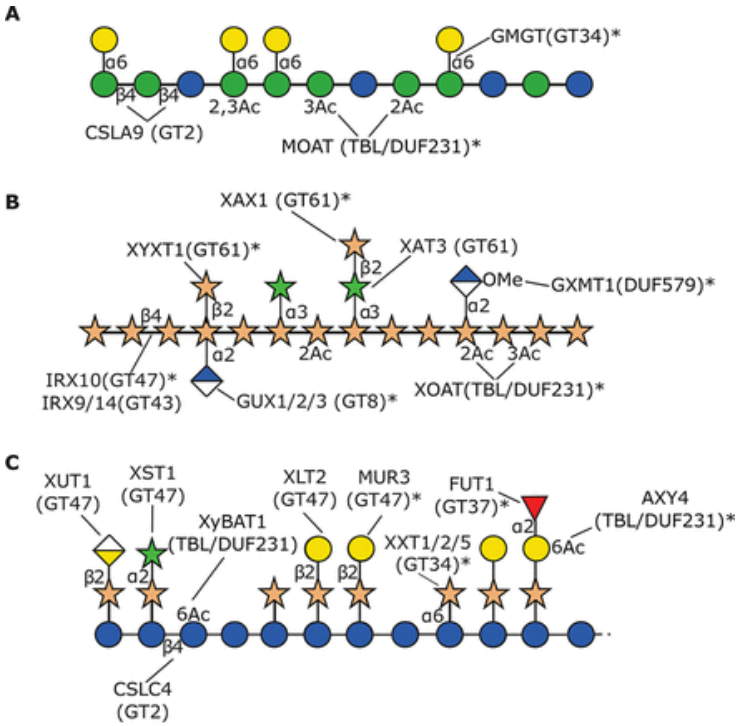
Approach

- Recent progress in the enzymatic synthesis of artificial polysaccharides is reviewed, with an emphasis on the potential of the synthesized products, either as new materials or as tools to study structure–property relationships of polysaccharides.
- Recent information on specificity of chosen enzymes for selective polymerization or sidechain derivatization is summarized. This can guide future developments of rationally designed plant biomass for the production of biobased materials for industrial and biomedical applications.



Enzymatic derivatization of polysaccharides obtained from plant biomass for functional analysis of structure-property relationships





Enzymes with known roles in the biosynthesis of plant hemicellulose: galactoglucomannan (A), xylan (B), and xyloglucan (C). The presence of an asterisk next to the enzyme name denotes that the enzyme has demonstrated *in vitro* activity.

Significance

- Our limited knowledge of the heterogeneous structures and the properties of biomass-derived polymers hampers improvements in their processing and a more rational design of final products. Polymer production in microorganisms or by *in vitro* synthesis with expressed enzymes allows full control over their structure and ultimately their physicochemical properties.

Smith, P. et al., 2020. Enzymatic Synthesis of Artificial Polysaccharides. *ACS Sust Chem Eng*, 8(32), pp.11853-11871. doi: 10.1021/acssuchemeng.0c03622
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